PHASE RULE
3 COMPONENTS SYSTEMS

Notes prepared by
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3 Components System

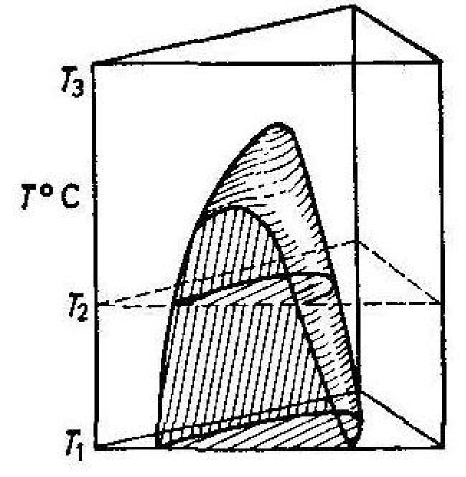
- For three-component systems the Phase Rule states that $P + F = 5$ and the maximum number of degrees of freedom is now four.
- Therefore, in one-phase systems, there will be four independent variables, namely, the temperature, the pressure and the concentrations of two of the components.

- The concentration of the third concentration is thereby fixed since, if two are *A* % &*B %*, the third must be :

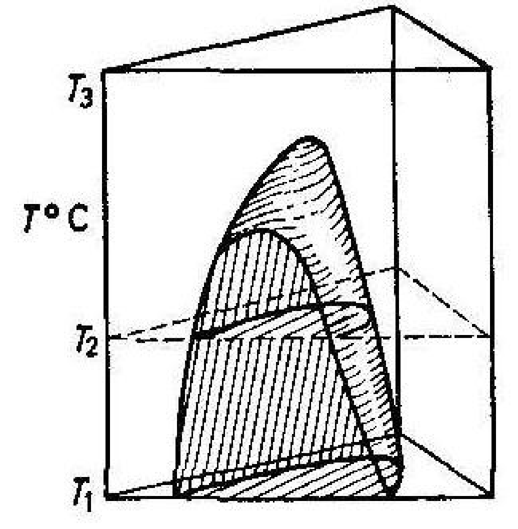
  (100 - *A* - *B)* %.

  Four variables ***cannot*** be represented graphically. Usually one variable is set at some constant practical value, for example, pressure is often considered fixed at 1 atm, and one degree of freedom is consequently surrendered.

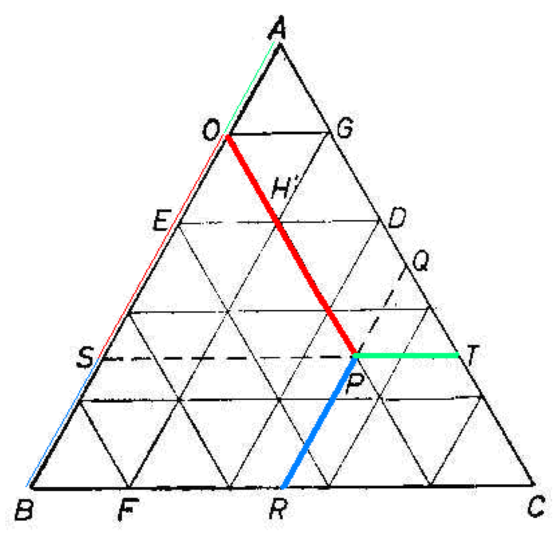
  The rest o s may then be plotted on a three-dim n having, as its base, an ***equilate***



Two sections of the three dimensional equilibrium curve at temperatures T1 and T2.



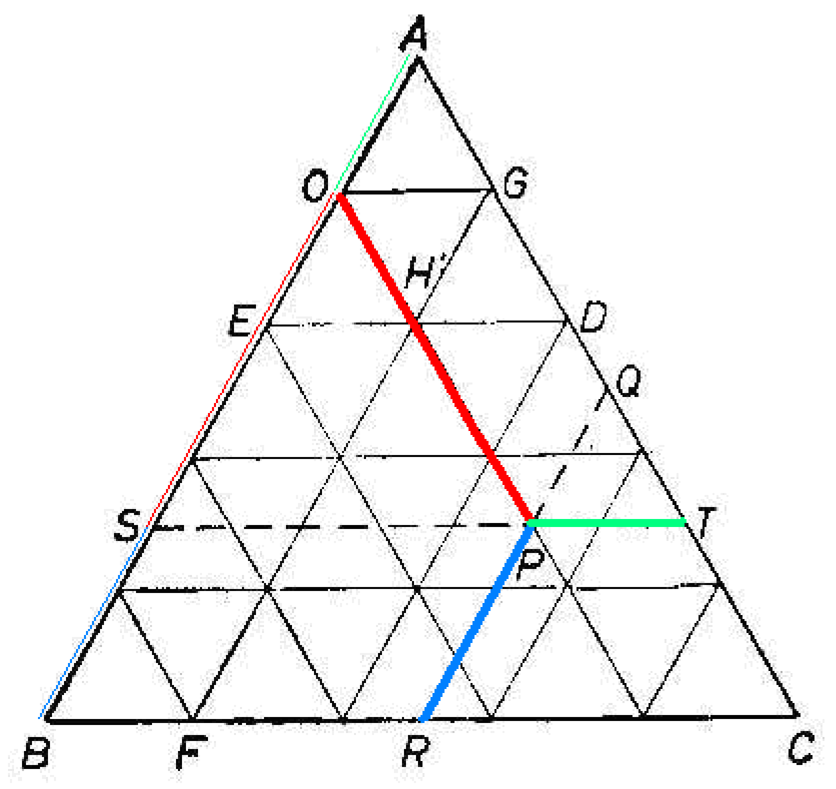
The concentration variables are plotted in the triangular axes and the temperature is scaled vertically. It follows that any horizontal section of the right prism represents a three-component system under fixed conditions of temperature and pressure, as illustrated in the adjacent figure .

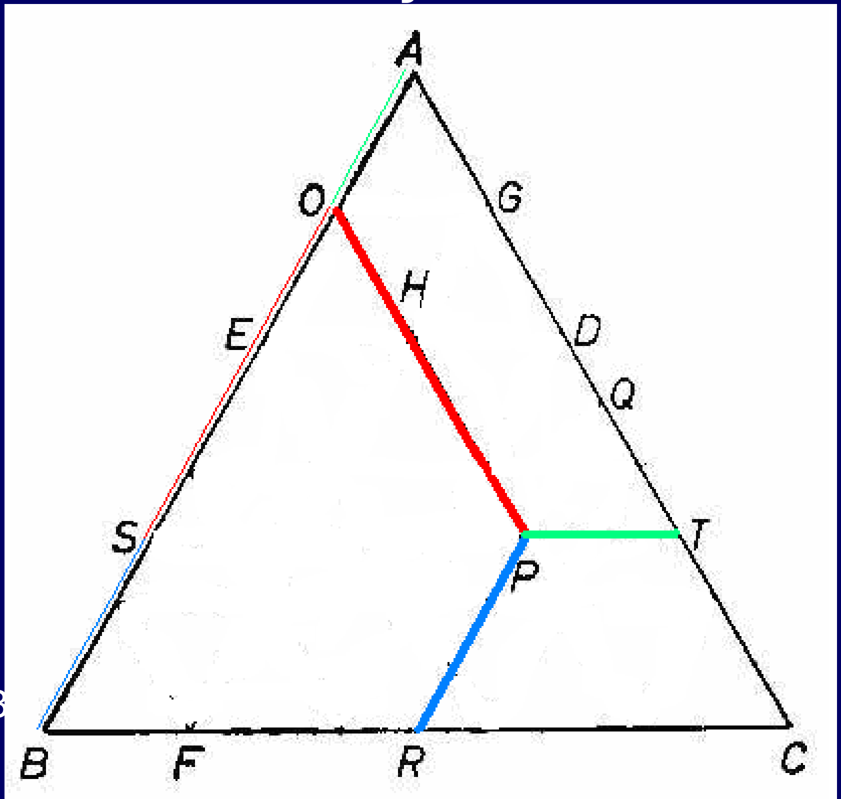


From any point *P* inside the figure lines *P0, PT* and *PR* are drawn parallel to *AC, BC* and *AB* respectively. The geometry is such that *P0+ PR + PT= AB* , Choosing *AB* as one unit or 100 per cent *P0+ PR + PT = 1* or 100 per cent.

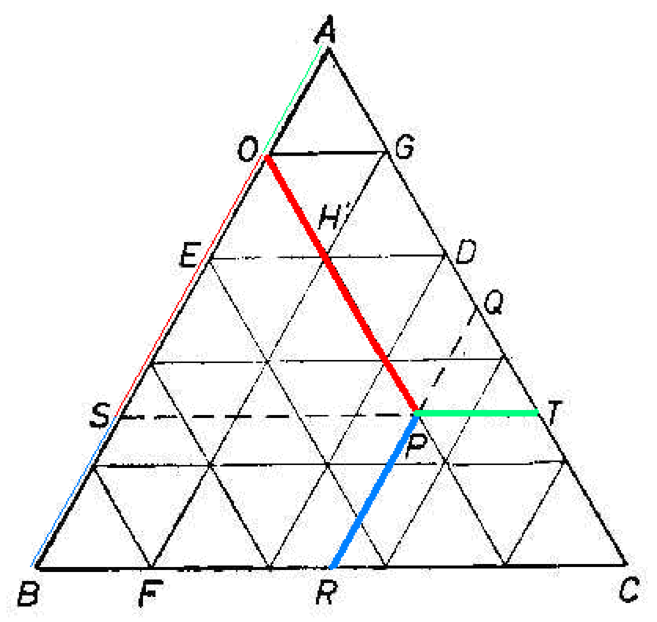
Concentration plotting

- Each corner of the triangle will represent a pure component, that is, 100%A, 100%B, *l00%C.* Each ***side*** will represent a ***binary*** mixture and the ***interior*** of the triangle represents all ***ternary*** compositions
- Hence the fraction or percentage of *A* will be given by *PR*, of *B* by *PT,* and of *C* by PO.



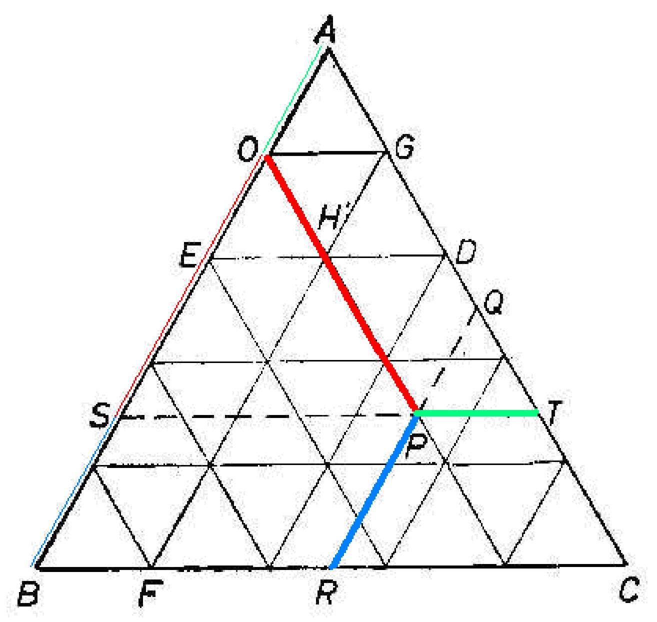


- (I) Point D represents a mixture of *A* and *C* such that
- In the above diagram, *D* corresponds to *60%A,* 40 *%C.* Similarly *E* represents a composition 60 *%A,* 40 *%B.*
- (2) A line parallel to one side of the triangle represents a constant percentage of one component. Thus all points on *DE* are for mixtures containing 60 *%A* with varying amounts of *B* and *C.* Similarly the line FG represents all mixtures containing 20 *%C.* These lines intersect at *H* which must be 60 *%A* e 20%B.



- (3) To plot the composition point *50%C, 30%A:*

  (a) Locate Q and *R* on sides *AC* and *BC* which represent *50 %C.* Join *QR.*
  (b) Locate S and *T* on sides *AB* and *AC* for mixtures which contain 30 *%A.* Join *ST.*
  (c) *ST* and *QR* intersect at P, the required composition point, 50%C, *30%A,* 20%B.



- (4) The geometry in the presentation *below* is such that a line through one corner represents all mixtures for which two of the components are in constant ratio to one another. Thus point X on ***AB*** represents a mixture of ***A*** and ***B*** in the ratio ***BX:XA.*** Any point on ***CX*** corresponds to a ternary mixture in which the ratio of ***A*** to ***B*** is always ***BX:XA.*** The line ***XC*** therefore signifies the dilution of an initial mixture X with pure ***C,*** while ***YX*** signifies the removal of ***C*** fr
ternary mixture of composition